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CONSEQUENCES OF PERSISTENT SMALL-SCALE BIOLOGICAL STRUCTURE ON UPPER OCEAN TROPHIC PROCESSES

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LONG-TERM GOALS

Our long-term goal is to quantify the interactions between small-scale biological and physical processes within the upper ocean and to determine the contribution of biological processes occurring on small spatial scales to those in the total upper ocean. This project has addressed that goal by measuring the distribution and variability in sub-1m scale bio-optical and physical properties in the upper ocean.

OBJECTIVES

Our scientific objectives are to determine the distribution and temporal coherence of persistent small-scale features (thin layers) of plankton biomass within the euphotic zone; to characterize the composition of these thin layers; to assess autotrophic and heterotrophic rate processes inside and outside of these persistent small scale features; to evaluate the contribution of biological rates occurring within layers to total water column processes; and to correlate the association of thin layers with shear, turbulent mixing, internal waves and local surface forcing conditions. We will accomplish this objective by integrating newly developed bio-optical and bio-acoustical instrumentation with a CTD and micro-rosette system into a free-fall package that will resolve physical, optical, and biological features over vertical scales of 1-3 cm, and bio-acoustic features over vertical scales of 20 cm. The profiler gives us the opportunity to address several important questions about bio/physical interactions on the small-scale.

This work is co-funded by NSF grant OCE-9618137.

APPROACH

We address the objectives outlined above through time-series deployments (4-6 per hour) of our free-fall profiling system. Typical deployment configurations have consisted of a Sea-Bird 911 CTD, ac-9 (2), SAFIRE, and MODAPS (data system). We will include an acoustic doppler velocimeter to measure small-scale horizontal shear, a bio-acoustic backscatter sensor to provide an index of zooplankton aggregation, a fast repetition rate fluorometer to provide an index of

photosynthetic potential, and a micro-rosette system that will enable us to obtain water samples within and outside of small-scale features. We also sample at coarser spatial scales by deploying the conventional shipboard CTD/rosette system. Water samples from both the micro-rosette and shipboard rosette systems will be analyzed for phytoplankton, bacteria, flagellate and protist enumeration, nutrients, chlorophyll, POC, DOC, ^{14}C uptake, bacterial production, and heterotrophic activity (CTC). We also deploy a thermistor chain off the vessel while time series are being acquired to help characterize the internal wave field, in addition to monitoring surface meteorological conditions with a shipboard meteorological package.

WORK COMPLETED

Funding has only recently been received. Nevertheless, during a cruise off of the Oregon coast in September 1997, we have acquired several time-series of profiles incorporating the acoustic doppler velocimeter and micro-rosette carousel into our free-fall profiling system. We have started to analyze the water samples collected. We have continued to develop data merging protocols for the new instruments on the profiling package (each instrument has a unique data format and acquisition rate). The fast repetition rate fluorometer was deployed on the ship's ctd system. And, the thermistor chain was successfully deployed during time series measurements.

RESULTS

Since funding was only recently received, and the first cruise just completed, we have no results to report yet.

IMPACT

The work's impact will not be known until the work is near completion.

TRANSITIONS

There are no transitions to report at this early stage in the work.

RELATED PROJECTS

Our ongoing work has led to direct field collaborations with the following ONR Principal Investigators:

Dr. J. Ronald Zaneveld, Oregon State University
Dr. Percy Donaghay, University of Rhode Island
Dr. Jan Rines, University of Rhode Island
Dr. Dian Gifford, University of Rhode Island
Dr. Alice Alldredge, UC Santa Barbara
Dr. Sally MacIntyre, UC Santa Barbara
Dr. Mary Jane Perry, University of Washington
Dr. Van Holliday, Tracor Systems